



LOUDOUN COUNTY

CABLING STANDARDS Category 6

ADOPTED MARCH 7, 2003

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COUNTY OF LOUDOUN CABLING STANDARD

I. PURPOSE OF STANDARD

The intent of this cabling standard is to provide a detailed document to be incorporated into all building design projects, new or rehabilitated, undertaken by the County of Loudoun and in all Requests for Proposals issued for leased space. The basis of this standard is EIA/TIA 568-A5, 569 and the proposed Category 6 standard. The purpose of this specification is to ensure that the County of Loudoun is provided with a standards compliant cabling solution with guaranteed "Channel" performance. **This solution will allow the County of Loudoun to maximize productivity and value by minimizing down time and maintenance requirements, thus protecting their investment for 20 years, while still providing for a future migration path to evolving technologies.**

II. RESPONSIBILITIES

The County of Loudoun Department of Information Technology (DIT) has the primary responsibility for compliance with this standard and provision of information cabling in existing County buildings, new County buildings and leased County buildings. It will be the responsibility of DIT to participate in all County Move Committee meetings to insure adequate information and voice, data, image and video cabling is provided. This includes coordination with the County Telecommunications Manager to insure adequate voice cable in conjunction with data cabling for all Moves, New Service and changed service. This responsibility includes:

- II.1 Management of the County Information Cable Plant, both exterior and interior;
- II.2 Coordination of all Cable Plant installation, maintenance and plant records; and
- II.3 Provision of EIA Cabling for New Service Relocation Services and Changes In Existing Services for County owned and leased space.

III. DETAILS OF THE CABLING STANDARD

III.1 COUNTY OWNED SPACE

A. Telephone Company Demarcation Point to Main Crossconnect (MC)

1. Minimum of 2 each 4" schedule 40 PVC conduits from the telephone room to telephone company junction point.
2. Conduits must meet approved bending radius standards.

B. **Main Crossconnect (MC).**

(For greater room/conduit detail, refer to ANSI/EIA/TIA 569-A.)

1. Typically one per building, centrally located within the building.
2. HVAC environment
 - a) The room should provide a human habitable environment.
 - b) No water lines should be permitted through or directly above it; ceiling must be designed to prevent water run off or spillage onto equipment or cross connect devices.
 - c) The floor should be painted or tiled and free of dust generation.
 - d) Designated walls should be covered in $\frac{3}{4}$ "fire rated" plywood backer board, one wall for telephone company, one for voice and one for data.
 - e) The room work lighting should be at least 50 candlefoot at work area height; fluorescent lighting is preferred with sufficient illumination in all four corners of the room.

3. Room is for exclusive use of communications equipment; no water or commercial power is to be distributed through it.
4. Size: proportional to size of building and/or number of sets/terminals to be installed with sufficient space for a work desk and a terminal to be installed for monitoring of on site equipment. Minimum size is 150 square feet or one square foot for each 100 square feet of floor space.
5. Electrical requirements: a minimum of one dedicated, 20 amp, isolated ground circuit terminated in National Electrical Manufacturers Association (NEMA) 5.20R receptacle on each wall. Typical spacing of receptacles for equipment is a quad every four feet of wall space. The equipment receptacles shall be served by the building UPS source (see j). All ups outlets should be wired to building back-up power, where available. Utility power shall be provided separately with one duplex outlet per every 50 SF.
6. A wall telephone is required.
7. 110P blocks or RJ45 jack fields will typically be used for termination of voice and data cables. Voice is terminated on the walls and RJ45 data panels are rack mounted in the center of the floor. Mounting hardware shall be marked with the following cable identification standards:
 - a. floor #,
 - b. TR,
 - c. directional quadrant (N,E,S,W),and
 - d. work station location.
8. Telecommunications Room (TR) should be situated directly above the Main Crossconnect (MC) in a "stacked" configuration when a building has multiple floors.
9. Conduit feed to TR (serving horizontal cable runs to station locations):
 - a) Minimum of 1-4" conduit from MC to each TR. Total number of conduit will be relative to the number of devices projected to be served by the TR.
 - b) Must meet approved bending radius standards.
10. The data and telecommunications systems shall be served by the building generator and uninterruptible power supply (UPS). The generator shall have at least a six hour capacity and the UPS shall be a minimum of 15 KVA.
11. Any County building with at least 150 occupants must have IT technician support space for staging and repairing computer equipment of at least 150 square feet.

C. Telecommunications Room (TR)

Note: For greater room/conduit detail, refer to EIA/TIA 569A.

1. At least one per floor, other than the floor with MC; more required if horizontal wiring runs exceed 90 meters.
2. All Rooms should be layed out in a stacked configuration with MC and other TRs.
3. Size: proportional to size of building and/or number of sets/terminals to be installed with sufficient space for a work desk and a terminal to be installed for monitoring of on site equipment. Typical size is approximately **150** square feet. Under no circumstances should Telecommunications Room be less than (10ft x 7ft).
4. In all other respects not listed in this section, the TR shall meet the same specifications detailed for the MC.

D. MC and TR Distribution to Office/Workstation.

Note: The following wiring systems description addresses horizontal/workstation and riser cable between closets.

1. Description of Standard Wiring Systems and Associated Components:
 - a. A structured/universal wiring system (SYSTIMAX® SCS) shall be used for interconnecting telephones, voice/data switches, local area networks (including personal computer and associated peripherals) and fax machines. These systems must have access to outside networks.

The wiring system, including both copper and fiber optic applications (in compliance with EIA/TIA 568-A (Commercial Building Wiring Standard) and the proposed Category 6 standard, shall utilize a set of subsystems to create a full cabling infrastructure within each building which can be quickly reconfigured to adapt to changes in technology or the user's environment. Vendors must use Avaya certified people, and provide system certification.

- b. The basis for the cabling system design is the Avaya SYSTIMAX Structured Cabling System (SCS), Its components and Application guides. The basic UTP Category 6 product is rated for positive ACR to 444 MHz (Avaya xx81 series UTP) and have guaranteed performance to 550 MHz. The entire SCS system is protected by a transferable Twenty (20) year physical component warranty that includes applications and labor.
2. The SYSTIMAX SCS structured/universal system standard supports subsystem wiring. Additional features include:

Support of the current and evolving standards, technologies and services such as Alalog Broadband Video to 550 MHz 77 Channels, Gigabit ATM, 1000BASE-T

Gigabit Ethernet, 622 Mbps 64-CAP ATM, 270 Mbps Digital Video, AES/EBU Digital Audio, 155 Mbps ATM, 100BASE-T Ethernet, 100 Mbps TP-PMD, Token Ring, 10BASE-T Ethernet, RS-485, RS-422, RS-232, ISDN (Integrated Services Digital Network), T-1, Switched-56, Modem, Fax, Analog Baseband Video/Audio, FDDI (Fiber Distributed Data Interface), and SONET (Synchronous Optical Network).

- a. Supports two types of transmission media: 1) AWG #24 unshielded twisted pair (UTP) copper as standard TIA/EIA 568-A Category 3, and Category 6; 2) and, 50 micron fiber using short wave VCSEL technology to support 10 Gb/s in the backbone to 300 meters and 50/125/900 microns core/cladding diameter, multimode, graded index fiber optic cables as standard for premises (between closets and campus applications concentrator) and other campus applications.
- b. Color coding at administration panels (within the MC and TRs) to identify the distribution fields should be as follows:

- (i) *Blue: Work Location and Horizontal cables*

- (ii) *White: Riser Backbone*

- (iii) *Brown: Campus Backbone*

- (iv) *Purple: Common equipment*

- (v) *Green: Incoming Telco trunks*

- (vi) *Orange: Multiplexed output*

- (vii) *Yellow: Auxiliary equipment*

- (viii) *Gray: Tie cable*

3. Wiring Specifics Relating to TRs and Distribution to Workstations:

The Telecommunications Room (TR) or wiring Room is the central point for intra-floor wiring and has a critical effect on the flexibility and maintenance of the wiring system. The TR contains cross connect blocks and certain LAN components such as wiring concentrators, communication controllers and multiplexers.

- a. Minimum of two outlets to each office (hardwall), one to each workstation.
- b. Cables will be identified at both ends with office/workroom, cable and workstation number based on numbering scheme of floor plan. Workstation numbering scheme is normally as follows: numbering starts in reception area and flows through in a logical sequence within the department.

c. Voice - data designation.

- (i) *Duplex jacks shall be designated with the office/workstation number plus voice and data. The top jack will be typically used for voice. The bottom jack is used for data.*

4. Color of jacks. The voice jack, (top) will be white or gray, depending on location on a wall (white) or system furniture (gray).
5. The data jack will always be orange.
6. Where cables exit walls into ceiling space, conduit will be stubbed.
7. If cable is to be installed in systems furniture, ends must be rolled, labeled and tied.

III.2 County Owned Building that has the Old IBM Type Cabling System Installed.

Note Rule: If the owned building is scheduled to have work done or relocations that total at least 50% of the installed work stations, the entire building should be recabled in compliance with the OWNED SPACE specifications of this standard. If the decision by DIT is not to recable, then the new cabling shall be done according to the Owned Building Standards. Type 1 cable shall no longer be installed.
All jacks will terminate both voice and data except as noted hereafter:

III.3 COUNTY LEASED SPACE

Leased space should be cabled according to the Owned Building Standards. Exceptions to the Standards may be made as determined by DIT, based on the length of the lease term and programmatic requirements.

IV. LIST OF SYSTIMAX® SCS MAJOR COMPONENTS as of May, 2001

The purpose of this section of the standard is to an overview of the key SCS components. This overview is provided as guidance only. The list is not all-inclusive and will change, for exact technical detail and updates the current Systimax® SCS specification should be referenced.

IV.1 Patchmax GigaSPEED™ Distribution Hardware

- A. Unshielded twisted-pair (UTP) cable termination blocks shall be a system of UL listed termination and connector blocks, label holders and insert labels utilized for cable terminators, identification and cross-connections.

1. The Patchmax Modular Jack Panel is a 19 in. (48.3 cm) modular jack panel.
 2. The rear of the panel features 110 type Connecting Blocks mounted on a printed wiring board (PWB).
 3. These connecting blocks are intended for use in terminating stations, equipment or tie cables.
 4. The panel, which is a 19 in. (48.3cm) EIA RS-310 rack mount unit, is available with 24, 48 jacks.
- B. The Patchmax Modular Jack Panels exceed the stringent requirements for connecting hardware as specified in EIA/TIA-568-A5, "Commercial Building Telecommunications Wiring Standard," when tested in accordance with the appropriate methods described in EIA/TIA-568-A5. Most importantly, the Patchmax Modular Patch Panels meet worst-pair Near End Crosstalk (NEXT) requirements over the entire frequency range for their respective categories on all pair combinations.
- C. The following products shall be used for data communications:
- Patchmax Modular Jack Panel: PM 2160GS-24, PM 2160GS-48 Comcodes: 108 619 347, 108 619 362 respectively.
- D8CM CAT6 Patch Cables: D8CM-2, D8CM-4, D8CM-6, D8CM-8, D8CM-14. Comcodes: 108-566-753, 108-566-779, 108-566-795, 108-566-811, 108-669-979 respectively.**

IV.2 Unshielded Twisted Pair Cables – Category 6

- A. Each conductor shall be unshielded AWG -24 solid copper and encased in a color coded plastic insulation according to the Band Marked Color Code used in standard telephone practice. Both wires in a pair shall twist around each other equally, and hence have the same length end-to-end, IAW Category 6. For a given pair, the inches per twist shall remain constant for its entire length. The twisted pair conductors shall be surrounded by an outer sheath which will be plenum. Each contractor should quote plenum cable.
- B. All new cable and wire installed in building air plenums and ducts shall be flame resistant and have low smoke properties in accordance with Article 800-3(d) of the National Electrical Code and shall be so classified by Underwriters Laboratories, Inc. All wiring must comply with Article 800 of the National Electrical Code and the American Standard Institute NESI (National Electrical Safety Code) as well as any pertinent state and local codes.

IV.3 Horizontal Cables

- A. High Performance Voice/Data Cable: The voice/data wire must meet or exceed the standards specifications for Category 6 cable performance.

The Category 6 standard shall become a part of the existing TIA/EIA 568-A5 standard and ultimately rolled into the suite of ANSI/EIA/TIA 568B Commercial Wiring Standard. Avaya 2081 cable approved

B. The cable shall be the following product:

1. Avaya 2081-1000 ft. Reel
2. The High Performance LAN cable (Avaya 2081) will be home run from the business locations and terminate on cross connect hardware in the respective wiring Room. The cable is capable of supporting up to 1 Gb/s Ethernet and 1.2 Gb/s ATM transmission rates for extended distances in building distribution systems.
3. Network applications include a 16 Mb/s token ring and a 100Mb/s CAD/Image network linking multiple workstations.

C. 2081 Electrical Specification:

Category 6 cables **Guaranteed electrical performance** to 550 MHz:

Freq (MHz)	Attn dB/100m	Cat 6 Industry Standard (dB)	81 Series NEXT (dB)	Cat 6 Industry Standard (dB)	81 Series PS NEXT (dB)	CAT 6 Industry Standard (dB)	81 Series ELFEXT (dB)	CAT 6 Industry Standard (dB)	81 Series PS ELFEXT	CAT 6 Industry Standard (dB)	81 Series Return Loss	CAT 6 Industry Standard (dB)
0.772	1.6	≤ 1.8	86.0	≤ 76.0	84.0	≤ 74.0	70.0	≤ 70.0	67.0	≤ 67.0	‡	‡
1	1.8	≤ 2.0	84.3	≤ 74.3	82.3	≤ 72.3	67.8	≤ 67.8	64.8	≤ 64.8	20	20
4	3.6	≤ 3.8	75.3	≤ 65.3	73.3	≤ 63.3	55.7	≤ 55.7	52.7	≤ 52.7	23	23
8	5.1	≤ 5.4	71.8	≤ 60.8	68.8	≤ 58.8	49.7	≤ 49.7	46.7	≤ 46.7	24.5	24.5
10	5.8	≤ 6.0	69.3	≤ 59.3	67.3	≤ 57.3	47.8	≤ 47.8	44.8	≤ 44.8	25	25
16	7.3	≤ 7.6	66.3	≤ 56.3	64.3	≤ 54.3	43.7	≤ 43.7	40.7	≤ 40.7	25	25
20	8.2	≤ 8.5	64.8	≤ 54.8	62.8	≤ 52.8	41.7	≤ 41.7	38.7	≤ 38.7	25	25
25	9.2	≤ 9.6	63.3	≤ 53.3	61.3	≤ 51.3	39.8	≤ 39.8	36.8	≤ 36.8	24	24
31.25	10.4	≤ 10.7	61.9	≤ 51.9	59.9	≤ 49.9	37.9	≤ 37.9	34.9	≤ 34.9	24	24
62.5	15.0	≤ 15.5	57.4	≤ 47.4	55.4	≤ 45.4	31.8	≤ 31.8	28.8	≤ 28.8	22	22
100	19.3	≤ 19.9	54.3	≤ 44.3	52.3	≤ 42.3	27.8	≤ 27.8	24.8	≤ 24.8	20	20
200	28.3	≤ 29.2	49.8	≤ 39.8	47.8	≤ 37.8	21.7	≤ 21.7	18.7	≤ 18.7	18	18
250	32.1	≤ 33.0	48.3	≤ 38.3	46.3	≤ 36.3	19.8	≤ 19.8	16.8	≤ 16.8	17	17
300	35.6	‡	47.2	‡	45.2	‡	18.2	‡	15.2	‡	17	‡
350	38.9	‡	46.2	‡	44.2	‡	16.9	‡	13.9	‡	16	‡
400	42.0	‡	45.3	‡	43.3	‡	15.7	‡	12.7	‡	16	‡
450	45.0	‡	44.5	‡	42.5	‡	14.7	‡	11.7	‡	16	‡
500	47.9	‡	43.8	‡	41.8	‡	13.8	‡	10.8	‡	15	‡
550	50.6	‡	43.2	‡	41.2	‡	12.9	‡	9.9	‡	15	‡

‡ Not Specified

Physical specifications:

	Plenum
Conductor size	24AWG
Flute	✓
Diameter	.24" nominal
Weight/k*	31.7 lbs.

* Reel weight is an additional 2.25 lbs.

IV.4 Jacks

The modular telecommunications outlets should be 8 position/8 conductor high density modular Information jacks designed for high speed networking applications using data transmission rates with frequencies up to 550 mhz. The MGS300BH outlet is universal and can be wired for either T568A or T568B pinnouts and is designed to snap into any M-Series modular faceplate. All County terminations shall use the **T568B** wiring pinnout.
Comcode: 108 601 899 Gray, 108 601 816 Orange

IV.5 Faceplates

- A. The M12AS will support two modules and is designed to be used in modular furniture raceway covers. (This is a plastic type faceplate that is flushmount and holds the I/O's at a 45 degree angle. Furniture faceplates would include the M13CLS, M14CE, M14C, M13C)
- B. The M12AP is a duplex-outlet that is designed with perpendicular openings. This faceplate is used as a flush mounted multi-outlet. Other modular faceplates may also be used in triplex, quadplex or sixplex installations. (This is a verticle faceplate one hole on top of another in a line.) For traditional flushmount faceplates use the M12L or M12LE.
- C. Wall faceplates shall match electrical faceplates in the building.

IV.6 Fiber Optic Cable

Fiber should be utilized to interconnect all TRs to ICs and the MC.

- A. The 50 micron MM fiber shall support single-channel serial transmission, in both the building riser and campus backbones, to 10 gigabits per second (Gb/s) for a distance of 300 meters with 4 connections.

1. The 50 micron fiber shall be backward compatible with legacy applications such as: Ethernet, Token Ring, FDDI, Fast Ethernet and Atm for in-building network distances) ensuring a smooth migration path from 10Mb/s to 10 Gb/s using achievable technology.
2. It shall support 10 Gb/s short wavelength (850 nm) emerging technology applications using vertical cavity surface emitting lasers (VCSELs) and low bit rate LED applications for legacy systems.
3. The 50 micron fiber shall be optimized to control differential mode delay (DMD) so that "pulse splitting" at 10 Gb/s is eliminated.
4. The high performance fiber shall use the same termination and test procedures that are currently used for the existing industry's lower performance 50 micron fiber. Fibers shall be manufactured with D-LUX® 100 coating for maximum color retention and protection.
5. The 50 micron fiber shall meet or exceed the following standards, as applicable, for OSP or Plenum cables: ICEA S-83-596, ISO/IEC-794, GR-409, EIA/TIA 455, EIA/TIA 492, EIA/TIA 568A-5, ANSI-FDDI, IEEE 802, UL 910, OFNP classification as described in the National Electric Code (NEC2), OFN-LS Low Smoke Cables, CSA Certified (OFN FT4/FT6) and SYSTIMAX SCS approved component industry standards.

B. Multimode fiber specifications:

The 50 micron multimode plenum building riser fiber shall meet the following technical specifications:

Optical fiber	50 micron multimode (10 Gigabit)
Fiber dimension	125 micron cladding 250 micron coating 900 micron buffering
Fiber proof stress	100 kpsi (689 N/mm ²)
Fiber core	50 μ m ($\pm 2 \mu$ m)
Core non-circularity	< 6%
Core/cladding concentricity error	< 3.0 μ m
Numerical aperture	0.200 +0.015/-0.010
Cladding diameter	125 μ m ($\pm 1 \mu$ m)
Cladding non-circularity	< 2%
Colored fiber diameter	250 μ m ($\pm 15 \mu$ m)
Buffering diameter	890 mm (± 50 mm)
Minimum tensile strength	100,000 psi
Fiber minimum bending radius	0.75 inch (1.19 cm)
Cable minimum bending radius	20 times cable diameter during installation 10 times cable diameter after installation
Maximum fiber loss	3.5 dB/km at 850 nm 1.5 dB/km at 1300 nm
Minimum Bandwidth	500 MHz-km at 850 nm (overfilled) 500 MHz-km at 1300 nm (overfilled) 2200 MHz-km at 850 nm (laser) 500 MHz-km at 1300 nm (laser)
Fiber identification	Individually color coded buffering
Buffer material	Plenum – Low Smoke PVC Color Coded

Jacket material	Plenum – Low Smoke PVC Aqua Color
Strength material	Aramid yarn
Operating temperature	(0dB added) -4°F to + 158°F (-20°C to +70°C)
Operating temperature	(less than 1.0dB added) -40°F to + 185°F (-40°C to +85°C)
Storage temperature	-40°F to + 158°F (-40°C to +70°C)
Normal reel length	Approx 12,000 feet (3,650m) (other lengths available)
Reel size	36" diameter, 19" wide alternate size 30" Diameter, 19" Wide

The 50 micron multimode plenum building riser fiber shall meet the following mechanical, environmental and optical testing requirements:

Cable Test	Test Method	Multimode Requirement
Temperature Cycling	TIA/EIA-455-3A; Test Cond. B-1	0.60 dB/km at 1300nm
Cable Aging	TIA/EIA-455-3A; Test Cond. B-1	1.20 dB/km at 1300nm
Strippability	TIA/EIA-455-178 FOTP-178	<i>Tight Buffered Fiber:</i> strip to the glass" 15mm +/- 1.5mm (.6 in +/- .06 in) of 900 um coating shall be removed with < 13.3N (3.0 lb-ft) and > 1.3N (.3 lb-ft) force. <i>Loose Buffered Fiber:</i> "strip leaving coating intact" 15mm +/- 1.5mm of 900 um coating shall be removed with < 13.3N (3.0 lb-ft)
Cyclic Flexing	TIA/EIA-104A	< .30dB for 90% of samples with 10% with loss .40dB
Impact	TIA/EIA-455-25A	MM loss< .30 dB for 90% of samples with 10% with loss .40dB
Cable Twist	TIA/EIA-455-85A	MM loss< .30 dB for 90% of samples with 10% with loss .40dB
High and Low Temperature Bend	TIA/EIA-455-37A	MM loss < .40 dB jacket cracking is failure; fiber break is failure
Compression	TIA/EIA-455-41A	MM loss < .40 dB No visible jacket damage allowed
Tensile Loading and Bending	TIA/EIA-455-33A	MM loss < .30 dB for 90% of samples with 10% with loss .40 dB

Avaya Communication BC-002D-ZPX, BC-004D-ZPX, BC-006D-ZPX, BC-012D-ZPX ACCUMAX LazrSPEED™ Plenum Multimode Building Cable approved.

C. Outside Plant Cable

The outside plant cable shall have a core consisting of 6, 12, 24, 48, or 96 multimode 50 micron fibers and shall have the fibers separated into 12-fiber (or greater), color-coded binder groups surrounded by plastic core tubes.

The core shall be filled with a water-blocking compound and be suitable for underground conduit, direct burial or aerial applications.

The cable shall be of dielectric LXE design with nonmetallic strength members parallel to and along the outside of the core. The sheath jacket shall be High-Density Polyethylene (HDPE) affording environmental protection.

The cable shall comply with Bellcore, FDDI and EIA standards.

The 50 micron multimode outside plant fiber cable shall meet the following technical specifications:

Optical fiber	50 micron multimode (10 Gigabit)
Tensile Load Rating	600 pounds (2,779N)
Minimum Bend Radius	10 times cable diameter under no load 20 times cable diameter under load
Outer Diameter	6-48 fibers: 0.51 in (13mm) 50-96 fibers: 0.61 in (15.5mm)
Weight	6-48 fibers: 95 lbm/kft (141 kg/km) 50-96 fibers: 125 lbm/kft (186 kg/km)
Operating Temperature Range	-40°F to + 158°F (-40°C to 70°C)
Minimum Bandwidth	500 MHz-km at 850 nm (overfilled) 500 MHz-km at 1300 nm (overfilled) 2200 MHz-km at 850 nm (laser) 500 MHz-km at 1300 nm (laser)
Maximum Attenuation	3.5 dB/km @ 850 nm 1.5 dB/km @ 1300 nm

The 50 micron multimode outside plant fiber shall meet the following mechanical, environmental and optical testing requirements:

Cable Test	Test Method*	OSP requirements	Notes
Tensile Loading and Bending	EIA/TIA-455-33 IEC 60794-1-E1	0.30 dB Max. Mean Added Loss	2
Cyclic Flexing	EIA/TIA-455-104 IEC 60794-1-E6	0.20 dB Max. Mean Added Loss	2
Cyclic Impact	EIA/TIA-455-25 IEC 60794-1-E4	0.40 dB Max. Mean Added Loss	2
Compressive Loading	EIA/TIA-455-41 IEC 60794-1-E3	0.20 dB Max. Mean Added Loss 440 N/cm (250 lbf/in) Load	2
Twist	EIA/TIA-455-85 IEC 60794-1-E7	0.20dB Max. Mean Added Loss	2
Low and High Temperature Bend	EIA/TIA-455-37 IEC 60794-1-E11	0.40dB Max. Mean Added Loss	2
External Freezing	EIA/TIA-455-98 IEC 60794-1-F6	0.20dB Max. Mean Added Loss	2
Fiber Strippability	EIA/TIA-455-178 No Equiv IEC proc	≤ 9.0 N (2 lbf) on unaged and aged fiber ≤ 1.0 N (0.2 lbf) on unaged and aged fiber	2
Temperature Cycling	EIA/TIA-455-3 IEC 60794-1-F1	≤ 0.5 dB/km Max Added Loss 80% ≤ 0.25 dB/km Added Loss	2
Cable Aging	EIA/TIA-455-3 IEC 60794-1-F1	≤ 1.0 dB/km Max Added Loss 80% ≤ 0.5 dB/km Added Loss	2
Water Penetration	EIA/TIA-455-82 IEC 60794-1-F5	No flow after one hour from one meter length of cable	1
Sheath-to-Ground Dielectric Strength		≤ 20kV for all armored metallic sheaths	2
Lightning Conduction	EIA/TIA-455-181 IEC***	IECA** Category 1 for all armoured metallic sheaths†	2

Notes:

1. Routine Requirements (RR)

2. Qualification Requirement (QR)

* Avaya complies with the latest revision of the TIA/EIA Test Method (There is not exact correspondence of TIA/EIA Fiber Optic Test Procedures (FOTPs) and IEC Test Methods.)

** ICEA categories are equivalent to those of Telecordia (Bellcore) GR-20

***Standard not yet published, but is under active consideration

† Mini-LXE (Armored Drop) is Category 2

Avaya Communication LDNX-006-HXG, LDNX-012-HXG, LDNX-024-HXG, LDNX-048-HXG and LDNX-096-HXG Multimode ACCUMAX LazrSPEED™ Dielectric Sheath Lightpack Cable Approved

D. 50 micron fiber apparatus

1. High Density Termination Shelf (Rack Mount)

The high density termination shelf shall be fully modular in design, provide security and protection, be accessible from both front and rear; and shall be capable of terminating buffered fiber optic building cable or direct termination of outside plant fibers.

The shelf shall be a 4U (7-inch high) designed for mounting in a 19-inch frame and be capable of handling terminations for up to 144 LC, 72 SC or 72 STII+ connections; and shall be equipped with color coded adapter strips for easy identification of 50 micron fiber optic cable.

The shelf shall contain built-in slack management for each adapter strip to facilitate fiber administration and have removable adapter bezels that are removable from the front to permit easy access to the rear connector and fiber.

Shelf dimensions: 7”h x 17”w x 11”d

Avaya Communication LSTLS High Density Termination Shelf approved

Avaya Communication LSTLS/MM/LC-144/7 (108 565 631) approved

Avaya Communication LSTLS/MM/SC-072/7 (108 565 649) approved

Avaya Communication LSTLS/MM/ST-072/7 (108 565 656) approved

2. Combination Shelves (Rack Mount)

a. Combination shelf with stationary shelf

The rack mount combination shelf shall be applicable for use in LANs, premises distribution systems, and small-count splice and termination applications.

The rack mount shelf shall be one-unit-high and be capable of housing 24 ST, 24 SC or 48 LC terminations, and shall have a detachable front panel facilitating access to the cable and connectors.

The shelf shall be capable of 24 fibers (48 with LCs) or to accommodate 48 mechanical splices, 64 fusion splices or 12 ribbon (mass fusion) splices using optional splice trays.

The shelf assembly shall consist of an aluminum tray that contains rear-corner slots for cable entry, steel brackets for frame mounting, fiber retainers for holding buffered fiber in place, and fiber storage drums for maintaining a bend radius of 1.5 inches (3.81) cm) for buffered fiber.

An optional door and cable manager shall be available for use when two shelves are stacked for an aesthetic appearance. This optional accessory shall be a 1U high (1.75") with a 3U door (5.25"). A top cover shall be available to protect from dust and falling debris.

Shelf dimensions: 1.72" (4.37 cm) H x 17.0" (43.18 cm) W x 8.0" (20.32 cm) D

Avaya Communication 600ALS Combination Shelf Approved
600ALS/MM/LC-48 Shelf for 48 LC connectors (108 565 698)

Approved

600ALS/MM/SC-24 Shelf for 24 SC connectors (108 565 706)

Approved

600ALS/MM/ST-24 Shelf for 24 ST connectors (108 565 714)

Approved

Options:

600ALS Lid Cover (108 565 433) Approved

DTLS/600A-5 Door with cable manager (108 565 482) Approved

1AF1-16LG Fusion Splice Organizer (105 356 562) Approved

1AMF1-6LG Mass Fusion Splice Organizer (105 545 451)

Approved

1AM1-12LG Mechanical Splice Organizer (105 356 570)

Approved

3. Combination shelf with sliding tray

The combination shall have a sliding tray with two 3-inch (7.7 cm) storage drums and two openings with liquid-tight cable fasteners. The sliding tray allows front access and installation of fibers.

The rack mount combination shelf shall be applicable for use in LANs, premises distribution systems, and small-count splice and termination applications.

The rack mount shelf shall be one-unit-high and be capable of housing 24 ST, 24 SC or 48 LC terminations.

The shelf shall be capable of 24 fibers (48 with LCs) or to accommodate 48 mechanical splices, 64 fusion splices or 12 ribbon (mass fusion) splices using optional splice trays.

The sliding tray shall ride on two self-locking nylon slides used for pulling the shelf away from the frame for front access to fibers.

An optional door and cable manager shall be available for use when two shelves are stacked for an aesthetic appearance. This optional accessory shall be a 1U high (1.75") with a 3U door (5.25"). A top cover shall be available to protect from dust and falling debris.

Shelf dimensions: 1.72" (4.37 cm) H x 17.19" (43.7 cm) W x 11.20" (28.5 cm) D

Avaya Communication 600BLS Combination Shelf Approved
600BLS/MM/LC-48 Shelf for 48 LC connectors (108 565 755)
Approved
600BLS/MM/SC-24 Shelf for 24 SC connectors (108 565 763)
Approved
600BLS/MM/ST-24 Shelf for 24 ST connectors (108 565 771)
Approved
Options:
600BLS Lid Cover (108 565 458) Approved
DTLS/600B-1.75 Door with cable manager (108 565 513)
Approved
1AF1-16LG Fusion Splice Organizer (105 356 562) Approved
1AMF1-6LG Mass Fusion Splice Organizer (105 545 451)
Approved
1AM1-12LG Mechanical Splice Organizer (105 356 570)
Approved

4. Distribution Panel (Wall/Rack Mount)

The distribution panel shall fit 1U rack space (1.72" high x 19" wide x 4.75" deep) and shall also be wall mountable with optional wall mount brackets.

The distribution shall be capable of terminating 48 LC, 24 SC or 24 ST connectors.

Color coded adapter shall be available to facilitate identification and administration of fibers.

Front access to the connectors and fibers shall be provided by removal of the adapter bezel from the front of the panel.

Avaya Communication 1100LS Fiber Distribution Panel Approved
1100LS/MM/LC-48 Panel for 48 LC Connectors (108 565 557)
Approved
1100LS/MM/SC-24 Panel for 24 SC connectors (108 565 573)
Approved
1100LS/MM/ST-24 Panel for 24 ST connectors (108 565 581)
Approved
Options:
Door with Cable Manager DTLS/600A-5 (108 565 482) Approved
3.5" Wall Adapter 1100C1-35-19 (106 830 573) Approved
7" Wall Adapter 1100C2-70-19 (106 830 581) Approved

5. LIU Termination Unit (Wall / Rack Mount)

The LIU termination unit shall be a modular enclosure that provides cross connect and /or interconnect, splicing and terminating capabilities

for outside plant and building cables. Although the LIUs are designed to be wall mounted they shall be rack mountable using available brackets.

The LIUs shall be available in the following two size capacities:

- a. The LIU shall be made of engineered polycarbonate material.

The LIU shall accept two adapter panels capable of terminating 12 fibers with SC/ST connectors or 24 fibers with LC connectors. It shall accommodate up to 12 mechanical or 12 fusion splices with an optional splicing kit.

Dimensions: 8.75" high x 7.5" wide x 3" deep

Avaya 100LS, 100 LIU Termination Unit (108 548 868) Approved
Note: Chose adapter panels and fiber splicing accessories from list below

- b. The LIU shall be made of aluminum.
- c. The LIU shall accept four adapter panels capable of terminating 24 fibers with SC/ST connectors or 48 fibers with LC connectors. It shall accommodate up to 24 mechanical or fusion splices with an optional splicing kit, but fiber termination is decreased to 12 ST or 24 LC connections.

Dimensions: 8.75" high x 7.5" wide x 4" deep

Avaya 200LS, 200 LIU Termination Unit (108 548 876) Approved

Note: Chose adapter panels and fiber splicing accessories from list below

Avaya Adapter Panels approved:

LC adapter panel 10PLC-LS (108 627 266) approved

SC adapter panel 10PSC-LS (108 627 274) approved

ST adapter panel 10PST-LS (108 627 282) approved

Avaya Splicing Accessories approved:

Mechanical Splice Kit D-181706 (105 289 656) approved

Fusion Splice Kit D-181707 (105 289 664) approved

Supplemental Mechanical Splice Kit* (106 726 714) approved

Supplemental Fusion Splice Kit* (106 726 705) approved

****Mechanical and Fusion Splice Kits are used for the first 12 splices. Supplemental Splice Kits can accommodate additional splices.***

6. Termination Panel (Rack Mount)

The termination panels shall be constructed of lightweight aluminum and comply with the EIA RS-310D standard for 19-inch (48.2 cm) frames. The panels shall mount on either a 19-inch rack/frame or 1100C-type wall mounted brackets.

The termination panels shall accept fiber distribution modules equipped with LC, STII+ or SC connectors for maximum flexibility. The termination panels shall be of two size capacities: 4-module panel (terminates 24 ST or SC connections, or 48 LC connections) and 8-module panel (terminates 48 ST or SC connections, or 96 LC connections).

Each ST or SC distribution module shall terminate 6 fibers. Each LC distribution module shall terminate 12 fibers.

Distribution modules shall snap into panel facilitating field assembly, installation and change-outs.

Fiber slack trays shall attach to the rear of the modules providing slack storage and proper bend radius of fibers. The fiber slack trays and modules shall be front removable.

Each module shall incorporate hinge-mounted, flip-up covers to protect adapter ports.

Dimensions:

4-Module Panel – 2U (3.5" h x 19" h x 8" d)

8-Module Panel – 4U (7" h x 19" h x 8" d)

Avaya Patchmax Termination Panel approved

2U Termination Shelf Kits:

PM2304LC/LC-48 for 48 LC Connections (108 662 024) approved

PM2304SC/SC-24 for 24 SC Connections (108 662 065) approved

PM2304ST/ST-24 for 24 ST Connections (108 662 107) approved

4U Termination Shelf Kits:

PM2304LC/LC-96 for 96 LC Connections (108 662 040) approved

PM2304SC/SC-48 for 48 SC Connections (108 662 081) approved

PM2304ST/ST-48 for 48 ST Connections (108 662 123) approved

7. Connectors and Adapters

The 10Gb/s 50 micron multimode fiber optic cable shall terminate on the following listed approved connectors and adapters:

Avaya Communication Connectors approved:

P1001A-Z-125 Multimode LC Connector (0.9 mm buffer) (107 764 292)

P2020C-Z-125 Multimode STII+ Connector (0.9 mm buffer) (106 812 274)

P6201A-Z-125 Multimode SC Connector (0.9 mm buffer) (106 917 800)

Avaya Communication Adapters approved:

C1001B-2-LS LazrSPEED LC Duplex Adapter (108 622 887)

C6061A-4-LS LazrSPEED SC Duplex Adapter (108 622 895)

C2000A-2 Multimode ST Adapter (104 148 028)

M81LS-LS Spool LC Duplex Adapter with fiber spool (108 623 109)

8. Patch Cords

The 10 Gb/s 50 micron multimode fiber optic solution shall utilize factory made patch cords. The patch cords shall be available in 4 ft, 6 ft, 10 ft, 20 ft, 30 ft, 40 ft, and 50 ft. lengths.

Avaya Communication Patch Cords approved:

Avaya Communication Duplex MiniCord Patch Cords

- **LC to LC MiniCord Patch Cord M22LC-LC-xx**
- **LC to SC MiniCord Patch Cord M22LC-SC-xx**
- **LC to STII+ MiniCord Patch Cord M22LC-EP-xx**

- STII+ to STII+ MiniCord Patch Cord M22EP-EP-xx
- SC to SC MiniCord Patch Cord M22SC-SC-xx

Avaya Communication Duplex MiniCord MTRJ Patch Cords

- LC to MTRJ MiniCord Patch Cord M22LC-MJ-xx
- SC to MTRJ MiniCord Patch Cord M22SC-MJ-xx
- STII+ to MTRJ MiniCord Patch Cord M22EP-MJ-xx

Avaya Communication 3.0 mm Patch Cords

- STII+ to STII+ Patch Cord LZEP-EP-xx
- SC to SC Patch Cord LZ2SC-SC-xx
- SC to STII+ Patch Cord LZ2SC-EP-xx

v. CABLE INSTALLATION REQUIREMENTS

The purpose of this section of the County Wiring and Cable Standard is to provide a general outline of the installation specifications that will be required of any contractor selected to provide the installation of wiring and cabling as defined in these standards. The installation specifications are a minimum requirement.

Cable vendors must be a certified Avaya Systimax SCS Installer or reseller and must provide a Avaya extended product warranty and applications assurance upon completion of the system.

v.1 Work Covered.

The work covered by these guidelines consists of furnishing and installing all equipment, materials, labor and services; related work; and performing all operations necessary to install and test the communications cabling system in all locations of each County building. The contractor shall provide all supervision, transportation, inspection, inventory and permanent records. The work shall include, but not be limited to, the following items:

- a) Information jacks: Administrative areas, work areas and LAN/computer areas
- b) Cable termination and patch panels
- c) Cabling (outdoor, indoor)
- d) Connectors, couplers, and panels
- e) Fiber optic splices and splice enclosures
- f) Hangers, brackets, mounting hardware and frame mountings
- g) Tie wraps, bushings and miscellaneous parts
- h) Conduits, innerducts, and fire-stop materials
- i) Tools and equipment necessary to complete the installation
- j) Cable sleeves and openings for routing backbone cabling
- k) Testing

- l) Protection of the County's premises and employees

V.2 Securing Cables.

Cables shall be securely held in place by an industry acceptable practice and installed with sufficient bending radius so as not to kink, shear or damage electrical conductors or optical fibers. Pulling tension shall be monitored with a dynamometer (tension gauge) to ensure that recommended tensile ratings are not exceeded.

V.3 Quantity of materials.

The contractor shall calculate all actual cable footage required. Contractor shall prepare a preliminary cable and wiring plan after inspecting the building plans, which describes the general methods to be applied in wiring the County's facilities. Such preliminary cable and wiring plan shall be included with contractor's proposal and shall include costs of each cable

V.4 Coordinate project phasing.

The contractor shall continuously coordinate work schedules and other details with the County's construction representative or designee.

- a) Prior to installation, the contractor shall examine and measure existing construction in involved areas, report conditions that interfere with or prevent correct installations and report conflicts between documents and actual conditions.
- b) The designated voice/data TRs or areas will be available to the contractor on a coordinated basis with the general contractor or the County's representative. The contractor shall be responsible for the shipping, handling, and storage of all equipment and materials, and to protect it from theft.
- c) The contractor shall obtain permission before proceeding with any work necessitating cutting into or through any part of the building structure such as girders, beams, concrete, finished floors or partition ceilings.

V.5 Repair of existing construction.

Contractor shall restore to original condition, at the contractor's expense, existing construction and improvement that are cut into, altered or damaged due to the contractor's operations. This includes matching adjoining surfaces and finishes.

V.6 Contractor must provide accurate cable records.

The contractor shall provide final cable records which detail copper riser and fiber optic backbone cable number, fiber count, pair count, telecommunications Room location, and type instrument. All jack locations shall be marked with a non-removable means. Records shall be provided in both electronic and paper format.

V.7 Final inspection of job.

Upon completion of all work functions, a final inspection or walk through with County representatives and the local Avaya SYSTIMAX Account Executive shall occur.

V.8 Shop Drawings.

Shop drawings shall include all parameters of operations and functions of the information cabling system, including all equipment, accessories, supporting details and their technical specifications. They should include drawings, manufacturers' catalogs, product codes, installation procedures, test procedures, and environmental conditions.

- a) Drawings shall include cable routes, termination points, pair and fiber assignments, labeling scheme and sample, proposed method of installation, and a schedule of work. Drawings shall be provided in electronic format compatible with the County's GIS.
- b) Contractor shall provide at least four (4) copies of the above details for the County's review and approval within fifteen (15) work days after award of the contract.

V.9 Specific Installation Requirements - Fiber

- A. Fiber Optic Termination Panels:
- B. Fiber optic termination panels shall be installed in the building TRs and MC as shown on the preliminary drawings and schedules. The panels shall be equipped with connector couplings for full capacity.
- C. ST-II connector couplings at the termination panels shall be protected with end caps at all times.

V.10 Specific Installation Requirements - Other

- A. The contractor must coordinate and work with the County and/or General Contractor on installation phases.
- B. Voice and data station cables shall be terminated at patchmax panels for data and 110P for voice in the building TRs and MC. All cables shall be continuous runs without splices between any two terminations or end points. However, the distance minimums for data must be assured.
- C. The maximum run of horizontal cable from any workstation to a TR must not exceed 90 meters. In buildings requiring risers, the horizontal distance is an extension of the backbone (riser) distance.

Note: The voice services will be distributed on CAT6 which will permit future expanded data networking within each building.

- D. The horizontal cabling shall consist of two, four-pair cables for each jack (two cables times 4 pair times two RJ45 jacks) at workstation wall plate where a telephone and/or computer will be located. Horizontal cables shall be terminated at both ends.
- E. The subsystems shall be cross-connected for end-to-end connectivity.
- F. The cables shall be labeled and numbered at each end and at intermediate access locations. Workstation jacks patchmax and 110P patch panels shall also be labeled according to the SYSTIMAX® SCS guidelines.

VI. General Construction Requirements

- A. The contractor shall be responsible for removing or laying aside ceiling tiles in order that it may complete its installation. When the installation has been completed in an area, the contractor shall replace the ceiling tiles immediately at the contractor's cost.
- B. The contractor shall be responsible for drilling the access holes to gain access through a wall or floor (or coordinating with the building's general contractor). Access holes in the buildings shall not be greater than two or three times the diameter of the cable being installed. The contractor shall provide sleeves at floor access holes, and protection above and below the floor and above surfaces where drilling occurs.
- C. Once all backbone cables have been placed, all sleeves and other passageways for carrying the backbone cable shall be plugged with an approved fire retardant plugging compound at each fire barrier penetration to meet local code requirements.
- D. The Contractor(s) shall at all times keep the adjacent areas of the property free from rubbish and the accumulation of any waste materials.
- E. Cable System Bonding and Grounding
- F. Bonding and grounding of all cables, frames and equipment shall be accomplished in accordance to NEC Article 250 and TIA/EIA-607. If ARMM riser cables are utilized, all cable sheaths shall be bonded to the termination panel using number 6 copper wire.
- G. All sheaths shall be bonded across any openings. Shield shall be grounded **to one end only**.

VII. Testing and Acceptance

- A. The contractor shall provide a thorough and current testing program for cabling acceptance testing. The testing should be done according to data equipment specifications as well as generally accepted practices.
- B. The County will assume voice is acceptable if all CAT 6 cable runs pass data testing. The County's representative may observe any or all testing.
- C. Final acceptance testing shall be performed jointly by the contractor and the County representative.
- D. The contractor shall provide procedures and a list of test equipment and operating instructions before the test. The contractor shall be responsible for understanding the latest Systimax[®] SCS test standards in order to insure the maximum benefit of the current Avaya guarantee (currently twenty (20) years).
- E. Testing of all copper wiring shall be performed prior to system cutover. 100 percent of the horizontal and riser wiring pairs shall be tested. Voice and data horizontal wiring pairs shall be tested from the information outlet to the TC. Testing shall be done with a TIA/EIA TSB-67 UL Certified Level III test set. For all unshielded twisted-pair connections, tests shall include, but not necessarily be limited to, polarity reversals, wire transpositions, continuity, AC and DC voltage, opens, shorts, power and ground faults and proper station operating conditions. Test shall also include length, mutual capacitance, characteristic impedance, attenuation, and near-end and far end crosstalk.
- F. Subsystems shall be tested individually before testing for end-to-end connectivity.
- G. All faults shall be corrected and tested. All test results shall be completely documented.

VIII. Fiber Optic Tests

- A. An Optical Loss Set (OLS) which combines the optical power meter (OPM) and optical source with adjustable output power level shall be used. The OLS/OPM shall display measured transmission loss directly in dB by comparing the optical power received after transmission through the fiber path to its own optical source power. Once this difference is adjusted to “zero” for a cable under test, all fibers in that cable are then measured relative to the “zeroed” source power and displayed in dB. The 938A OLS/OPM, Comcode 104 374 137, meets these requirements.
- B. Tests shall be conducted at the wavelengths of 850 nm and 1300 nm and loss will be measured in the A to B direction, LAB, at B. The contractor will measure the loss in the B to A opposite direction, LAB, at A and calculate fiber path loss by averaging the loss measurements, (loss A to B + loss B to A) divided by 2. The 937A Optical Intercom (Comcode 104 373 129) can be used to provide two-way communication on fibers during testing. All measured and calculated losses shall be recorded in a table similar to the one shown below. The table shall also be available on PC-based spreadsheet in ASCII format.
- C. Optical Fiber Transmission Loss Measurements:

Mode:		Wavelength:		Date:		Page:	
Hub Site Label	Fiber Number	Color Code	Fiber Length Feet	Loss A to B dB	Loss B to A dB	Loss Average (E+F)/2dB	Design Loss D/3284xM+ dB
A	B	C	D	E	F	G	H

3284 feet = 1 kilometer = 1000 meters

M = 3.4 dB/km @ 850 nm, 1.00 dB/km @ 1300 nm

N = Connector Loss = number of connectors x 0.3dB loss each in a span

S = Splice Loss = .20 dB each splice in a cable span

- D. All fiber path transmission losses must be compared with the design loss values. A fiber path loss which is higher than the design loss indicates a problem with the measurement or fiber path. The measured transmission loss is first confirmed using the above procedures, including cleaning and inspecting the connectors. Then the fiber path is checked to determine the cause or causes of high loss such as

improperly constructed terminations, damaged connectors, pinched fiber, et cetera. All faults shall be corrected and retested.

IX. Acceptance Tests

- A. Upon completion of all tests, two copies of test results shall be submitted for review. Prior to cutover, the contractor shall perform a random sampling test jointly with the County's representative, of one in six workstation circuits selected by the County representative, to verify conformance to the specifications.
- B. Tests shall be repeated for any faults found at this stage. Test documents shall be revised accordingly. A final walk through inspection with the County representative should be completed at this stage.
- C. The County representative shall confirm, in writing, acceptance of the installation and tests upon receiving two copies of the final test results. A copy of the test results and Avaya Warranty Certificate shall be retained by the County as part of the permanent cable installation record per each building.
- D. The Contractor shall provide the County an original Systimax SCS 30 warranty for each project. Final payment will not be made until the documentation, testing, and warranty documents are provided and accepted.